enhanced energy absorption occurs due to the multiple layer structures of the human head; (3) nonuniform bone structures, such as internal ridges of the skull, causing increased energy absorption at some regions; and (4) dramatic increases in energy absorbed in the brain as a result of metal objects, such as metal-framed eyeglasses, in close proximity to the transmitting antenna.

Certainly this collection of scientific data should alert intelligent researchers to the prospect for harmful interaction from radiofrequency radiation. This should be especially obvious when considering placing a radiating antenna less than one inch from the head or brain of a human or when considering what safe radiation exposure conditions should be established.

Dr. Swicord, formerly of the U.S. Food and Drug Administration and now with Motorola, proposed some years ago that the exposure limits should be reduced—that is, made more restricted. He stated that

> ***at the FDA, we get information from medical device manufacturers which states that they can get beneficial effects at levels specified as safe in this guide. 145***

The medical benefits of which Swicord spoke include deep tissue heating. The guide he was speaking of is the ANSI C95.1 —1982 safety standard. That guide has supposedly established the "safe exposure" level so that no thermal, biological, or behavioral effects will occur.

That "safe" level is supposed to be ten times lower than any reported effects. Nonetheless, we read that the

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145 "Revising ANSI RF/MW Limits: Debate Often Contentious," Microwave News 9, no. 5 (September/October 1989).

FDA representative protests he has knowledge of these effects occurring at radiation levels lower than the "safe" level. That means the safety standards must be reduced by at least a factor of 10. Or at the very least the commit we should certainly investigate the exposures. But, that did not happen. Swicord was overruled.

One other point on the IEEE/ANSI safety standard issue: As of 1989 the revised safety standard had not been approved. This was primarily due to the divisive interests among the committee members. As *Microwave News* noted,

The standard has a long way to go before publication. When it is completed, it must be approved by a number of different committees. Some members such as Pollack [Dr. Herbert Pollack] and Swicord, are betting that the standard will never be approved. "[146]

The revisions that were originally argued during the 1980s became the revised safety standard C95.1—199O and again evolved into yet another version that eventually became C95.1-1992. ANSI has finally adopted the revised safety standard, but that does not mean to say that it has been adopted by the industry or government agencies. However, *Microwave News* has reported that the Board of Standards Review is investigating comments made by Dr. Swicord. Dr. Swicord is quoted as stating that

it is generally recognized that the current member-ship is not balanced in representing government, industry, and the general public. [147]

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[146] *Ibid.*

[147] *"AN SI OKs RF/MW Standard; Questions Makeup of Committee," Microwave News 12, no. 6 (November/December 1992).*

As the entire research base points out, deep tissue destruction may have occurred by the time a warming sensation is felt in the skin. Thus we should not reasonably expect to be unharmed by these exposures just because no sensation of heat or pain is felt on the skin or scalp. We would also not expect that a laboratory animal would provide a behavioral symptom under similar exposure. We have already discussed how the brain is relatively insensitive to pain or thermal sensation. This being the case, tissue destruction in one's brain or the brain of a laboratory test subject may be occurring without the slightest indication that anything is happening. And the damage may be repeated, over and over again, each time the energy exposure takes place.

Absorbed energy levels in humans, more particularly in the human brain, have been determined analytically by computer methods and experimentally verified with laboratory models. Over the years both computer methods and laboratory models continue to increase in level of sophistication and, we trust, accuracy. From those scientific tools we know that the everyday exposures to radiofrequency energy due to operation of portable cellular telephones exceed the stated SAR safety levels.

The IRPA (International Radiation Protection Agency) has adopted 0.4 mW/g as a safe exposure level for humans based on behavioral effects in animals at 4 mW/g. Researchers have measured from 2 to 8 mW/g peak levels in laboratory models of human heads with portable cellular telephones in the operating position.

The best remedy is to avoid the use of the apparatus that causes the damaging exposure. Interestingly, that is exactly what some industry statements have advised.

They recommend only using the telephones for emergencies and using regular telephones for all other communication needs. They further recommend to limit the duration of calls to the absolute minimum. Can you imagine going to an automobile dealer and having him tell you not to drive your new car except in emergency situations and to limit your use to an absolute minimum? Wouldn't you be a little bit curious about the reasons?

We have already made note of the recent dramatic increase in near-zone exposures as a result of portable cellular telephones, but it is also important to tie this new epidemic of exposures to what researchers have been warning about since the 197 Os. That is, accepted concepts and standards were based on simple plane—wave (far zone) electromagnetic field propagation and were inadequate for the complicated near-zone fields.[148]

The industry typically proclaims that their portables are well within the requirements of the safety standards.
First of all, it must be made clear that the safety standard has been worded to exempt portable cellular phones from safety requirements or limitations of exposure to humans. One industry manufacturer has boldly stated, in an internal industry memorandum, that the portables are completely exempted from the safety standards.[149] If the exemption were to be removed and portable cellular telephones tested for compliance, it would be found that exposures are well in excess of the safety standard levels.

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[148] *P. F. Wacker and R. R. Bowman, "Quantifying Hazardous Electromagnetic Fields: Scientific Basis and Practical Considerations," IEEE Transactions on Microwave Theory and Techniques MTT—19, no. 2 (February, 1971):178-87.*

[149] *Memorandum, Motorola, Inc., to Ameritech Mobile Communicntions, September 12, 1984.*

11

Who among you would consider sitting down in front of your microwave oven with the side of your head about one-half inch away from the door while the oven was in operation? Who among you would consider doing so for fifteen or thirty minutes? Microwave ovens are regulated to emit a very low level of radiofrequency energy, less than 1.0 mW/cm^2. This regulation is in effect for a good reason, that being that the very energy that is heating and cooking the food inside the oven may do exactly the same thing outside the oven.

So for microwave ovens the radiofrequency energy is regulated to be confined within. However, operating a portable cellular telephone exposes the user to higher radiofrequency radiation levels than does sitting next to a microwave oven. Why, you may ask, is it necessary to limit radiation exposure for microwave ovens in the first case but not limit exposure to radiation from cellular telephones in the second case? The answer lies in the regulatory process.

The safe exposure level for microwave ovens has been established at 1.0 mW/cm^2 Public exposures to broadcast transmission towers reach levels in excess of 10 mW/cm^2. Portable cellular telephone users are exposed, regularly, to radiation levels even higher. Any flim-flam man can provide "proof' to support whatever scam he may be promoting at any given moment. In the case of the $100 billion dollar cellular telephone industry the spokesmen and in-house researchers had a particularly interesting explanation for why they thought the high-level radiation very close to portable cellular telephones was not dangerous. These individuals, speaking for the industry, had concluded that the

electromagnetic fields near portable transmitter antennas were of a "peculiar nature" and that physical principles did not apply.

The industry exempted portable hand-held transmitters from everyday physics, and the regulatory agencies, relying on the expertise of the industry researchers, bought the line. Today we know that even though the industry researchers declared cellular telephone radiations exempt from the laws of physics, the rest of the universe has not. The evidence proves the notion of "peculiar" electromagnetic radiation to be foolish and without scientific basis.

On the representations from industry researchers, standards-setting agencies, such as the American National Standards Institute, exempted portable transmitters from any safety requirements. The repeal of that exemption to safety standards, which the cellular telephone manufacturers lobbied into existence, has finally occurred. The FCC, however, will not retroactively place exposure limits on existing models of portable cellular telephones. The reason is that in doing so consumers would learn that most of their portables operate above the accepted safety levels and either widespread outrage or panic would result. Can you imagine the concern when the 80 million owners and 150 million regular users of portable cellular telephones learn that use of these phones exposed them to excessive levels of radiofrequency radiation: that is, levels of absorbed energy into their heads that have already been shown to result in brain tissue damage?

Research Labs: The Good, The Bad

and the Biased

In any science there is a harmony between practitioners. A man may work as an individual, learning of what his colleagues do through reading or conversation; or he may be working as a member of a group on problems whose technical equipment is solitary in his own study. He, as a professional, is a member of a community. His colleagues in his own branch of science will be grateful to him for the inventive or creative thoughts he has, will welcome his criticism. His world and work will be objectively communicable and he will be quite sure that, if there is error in it, that error will not be long undetected.

--J. Robert Oppenheimer

1

Over the period of the 1970s and 1980s, during which the cellular telephone system was being engineered and developed, virtually no industry-sponsored research took place to determine the biological impact that portable cellular telephones could have on humans. Extensive research was conducted and reported on the transmission

and reception characteristics of the cellular system. Conferences were held and dedicated to the evolving scientific and engineering understanding of the cellular telephone system. Careers and fortunes were risked and made with the evolution of that technology, but the research into the biological effects never happened within the industry.

Before we ask why the researchers, in general, never performed the research, it is necessary to understand the "research-funding engine." In order that a program or set of experiments can be performed there must be a sponsor to pay for it. Outside of the industry's own labs, no professors or scientists can afford, for long, to engage in research for which there is no funding. How do you imagine laboratories, equipment, technicians, and other daily expenses could be paid for if not through funding of each and every program?

Now, from where does funding, or payment, for research come? Do universities provide money to their professors to conduct research? Not likely, for they have a difficult enough time meeting educational and administrative needs without doling out funds to researchers. Tobthe contrary, universities typically rely on their researchers to bring moneyinto the system by going out and actively pursuing research grants.

If that's the case, then who provides the funding?

For one, the U.S. government is a good source of research funding. But the government usually only provides funding in technical and medical areas that have been previously identified as being of strategic importance, such as development of the semiconductor industry, or for topics that have raised alarms in the populace, such as the effects of exposure to electric fields from power lines.

More typically, university and independent researchers must rely on industry to fund their programs. But that reliance also tends to remove the independence. With industry in the driver's seat it would not be unreasonable to expect that research that will provide favor-able results will be enthusiastically funded, while programs that are likely to provide potentially detrimental results are less likely to be funded.

Further, private industry-funded research often involves contracts drawn in a manner that allows the industry sponsor to own the results. Other contracts are drafted so that the industry sponsor can edit or censor publication of research results. Private corporations are not foolish. If they're paying the bills, they want some control.

On one side of the balance we have industry, which seems to have a stranglehold on the funding pipeline. On the other side are independent researchers who propose research that delves into areas that industry is less than enthusiastic to have cultivated.

The small amount of industry-funded research, more often than not, seems to be designed in a way that would make it difficult to come up with findings adverse to the industry's own product interests. This is called file building. By performing many research experiments that don't find a cause, or effect, or harmful exposure the industry can hope to argue by volume of research instead of validity or quality.

Occasionally the industry-funded research does report adverse results. When that happens and the research cannot be withheld from publication, there is usually some kind of "spin control" used in the discussions and conclusions of the report in an attempt to diminish the importance of the findings and to divert the reviewers' attention elsewhere.

On the other side we will always have some enterprising nonindustry scientists who still manage to perform meaningful bio-effects research. We should be grateful for those few, because they usually force the full research community into areas that industry would prefer be left uninvestigated.

Most of the credible biological effects research has been funded to some extent, and to the credit of the U.S. government, by various federal health organizations. Although much more should have been done (but that's always the case in hindsight), the research base that was established is sufficient to complete the picture.

It might seem unlikely, but also on the industry side of the balance there is a storehouse of available published research. That industry data clearly indicates that the cellular telephone manufacturers and service providers knew, or should have known, through their own studies that exposure of humans to radiofrequency radiation emitted by transmitting portable cellular telephones is dangerous and causes biological and cognitive effects. However, the cellular industry manufacturers and service providers never cite this research.

We may think of researchers as being in either one of two possible groups—that is, those who are proponents of the telecommunications industry and those who are skeptical of the claims of the industry. Of particular interest should be the type of research conducted by each group. Those who attempt to confirm the safety of exposure of humans to electromagnetic energy typically conduct experiments that are nonrepresentative of actual exposures to humans and imply or explicitly claim that there is no danger. Many of the conclusions drawn by these researchers are extrapolations based on results obtained from studies of unrealistic models and plastic dolls

irradiated under circumstances much different from those used by persons operating portable transmitting devices. Many studies have been designed and reported that utilize bizarre laboratory models that provide data from which claims of safety for humans are made.

On the other end of the researcher spectrum we have the skeptical scientists who, once they have overcome the obstacles of funding, more often than not perform and report research that does not agree with the body of industry-sponsored work. In nearly all instances the new research findings and indications of hazards are reported by those researchers who are not funded by the industry.

If the system Worked differently, if the research community could draw from a pool of resources made available without contingencies imposed by the founder, then we might expect most or all of the research reports to indicate the same thing—that is, exposure to radiofrequency radiation results in biological effects to humans, some of which are temporarily disabling, some of which are permanently damaging, and still others that lead to fatal disease.

2

During the 1950s university researchers provided experimental evidence that electromagnetic waves result in effective, rapid, deep, localized tissue heating.[150] The deepest penetration of energy and greatest temperature rise was provided by radiators, or antennas, using reflectors. The reflectors are useful in redirecting some of the

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[150] *H. P. Schwan and G. M. Piersol, "The Absorption of Electromagnetic Energy in Body Tissues," International Review of Physical Medicine and Rehabilitation, June 1955, pp. 424-48.*

radiated energy back toward the subject. In that way, not only does the subject absorb the energy with which it would normally come in contact but it also would absorb some of the reflected energy. It's exactly the same as using a sun reflector while sunbathing.

However, in the case of radiofrequency energy reflections the extra energy absorption may not be desirable. It depends on the purpose of the radiofrequency radiation. If the energy is intended for use with a diathermy or hyperthermia application, then the extra reflected energy may be of value. If the intended purpose of the radiation is for communications, such as a cellular telephone call, then any radiation absorption is not desirable; and extra radiation absorption from reflections is equally undesirable.

These research results have become increasingly important in view of the fact that not only do many operators of portable cellular telephones utilize the devices from within their automobiles but also from the fact that a large percentage of portable cellular telephone user wear metal-framed eyeglasses.

The connection to automobile use is important because the reflective metal components, components that virtually surround the occupants, play a part in modifying and enhancing the energy directed toward the head of a user. Some of the radiation from antennas located within an automobile will be reflected by the metal structure. Persons inside the automobile will absorb some of the reflected radiofrequency energy—in addition to that which they will absorb due to direct exposure. If the reflecting structure is very close, such as a door post or the metal roof, the reflected energy can be significant.

In their 1955 summary of the available research university scientists cautioned that

metal objects can modify the electromagnetic field and its effects. Any of these objects may concentrate the field . . . 151

When one is making a telephone call with a portable phone the area around the antenna is exposed to a high level of radiofrequency energy. Placing metal objects in the region of antennas and biological tissue can cause significant changes to the radiofrequency radiation patterns and energy absorption. In some cases the changes dramatically increase the amount of energy that is absorbed within parts of the brain.

M. Stuchly, et al., have found that "a resonant dipole with a reflector, may be considered as representing the worst-cause conditions, as the energy couples very well to the body."152 The "worst—cause" of which the researchers speak is maximum energy absorption. They are acknowledging that a radiating dipole antenna (resonant dipole in this instance) near a reflector will be the most dangerous in terms of depositing energy into a user. Many portable cellular telephones employ dipole antenna structures to radiate the energy.

Reflecting objects have been shown to provide large enhancements in the energy absorbed by human operators, and also induce local "hot spots" in the human brain. Another undesirable effect is produced with portable cellular telephone operators who wear metal-framed eyeglasses.

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151 H. P. Schwan and G. M. Piersol, "The Absorption of Electromagnetic Energy in Body `l`issues," International Review of Physical Medicine and Rehabilitation, June 1955, pp. 424-48.

152 M. Stuchly, "Exposure of` Human Models in the Near and Far Field-A Comparison," IEEE Transactions on Biomedical Engineering BME—32, no. 8 (August 1985):609-16.

The metal frames are good conductors and tend to redirect and focus the radiating energy in a way that causes increased deposition into the head and brain. N. Davies and D. W. Griffin reported that

> ***it has been found that the introduction of a pair of metal-framed spectacles can, in certain cases, cause an increase in field levels by up to approximately 20dB [ten times], a significant perturbation of the incident microwave field which should be accounted for in the setting of safety standards relating to acceptable levels of incident power.*** [153]

Clearly these researchers have warned that the effects of metal-framed eyeglasses must he considered when establishing safety standards. To date that effect has not been considered, nor has any other effect of reflectors.

The issue of metal-framed eyeglasses as an enhancer of radiofrequency energy absorption has been confirmed repeatedly but not passed along to users of portable phones. A number of independent researchers have reported that wearers of metal-framed eyeglasses who use portables will suffer an increase in absorbed radiofrequency radiation of up to 60 percent more than users who do not wear metal-framed eyeglasses. Since portable cellular telephone users are known to absorb about 50 percent of the total energy that the antenna radiates, the enhancement from metal-framed eyeglasses means that those users will absorb about 80 percent of the total radiated power.

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[153] *N. Davies and D. W. Griffin, "Effect of Metal-Framed Spectacles on Microwave Radiation Hazards to the Eyes of Humans," Medical and Biological Engineering and Computing, March 1989, pp. 191-97.*

Also at the 1994 BEMS conference, A. H. J. Fleming reported calculations that indicate RF energy absorption by users of portable cellular telephones is in excess of 1 mW/g and recommended that some form of shielding should be incorporated to reduce the absorption of energy by the operator.[154] The researchers also confirmed that the presence of metal—framed eyeglasses will, in accordance with their experimental findings, result in a significant increase in radiation absorption.

3

Independent researchers agreed, for once, with industry researchers when the former acknowledged that work must continue to quantify near-zone exposures that are of great concern.[155] At that time, 1980, the university researchers, of course, could not anticipate the explosive growth of portable cellular telephones, but the industry researchers were well aware of the product development within their own labs. The independent scientists, were, concerned about the dangers of energy absorption due to near-zone exposures from other radiofrequency radiation sources.

Of most significance, at that time, was the position of the researchers that there had been little work done

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[154] *A. H. J. Fleming, "A numericul Estimate of SAR Levels in a Heterogeneous Model of the Head due to Exposure by a Mobile Phone," 16th Annual Bioelectromagnetics Society Meeting, June 12-17, 1994, abstract book, p. 65.*

[155] *I. Chatterjee, et al., "EIectromagnetic-Energy Deposition in an Inhomogeneous Block Model of Mun for N ear-Field Irradiation Conditions," IEEE Transactions on Microwave Theory and Techniques MTT-28, no. 12 (December 1980):1452-59.*